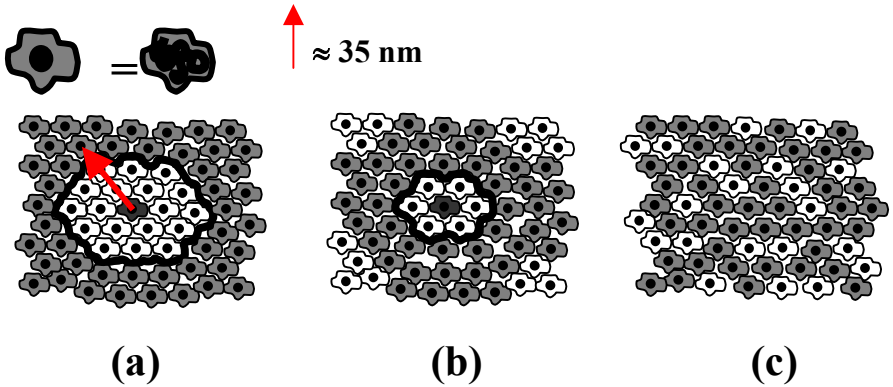
Polyolefin Blend Miscibility: An Experimental Molecular View

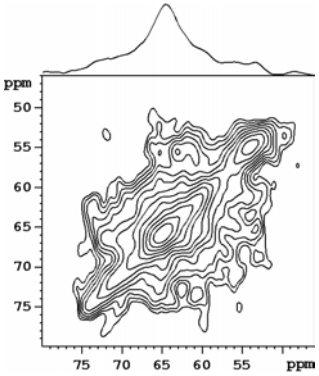
Jeffery L. White, North Carolina State Univ., DMR-0137968

As a result of systematic evaluations of both conformational dynamics for individual polymer chains and length scales of mixing in several strategically selected polyolefin blends, we have shown that (1) polyisobutylene is miscible only with polyethylene-butene copolymers containing specific amounts of 1-butene comonomer, and that (2) configurational entropy increases by a factor of > 3 for these miscible systems, strongly suggesting that configurational entropy is a thermodynamic driver for mixing in polyolefins. These results are the first examples which quantitatively indicate how configurational entropy contributes to mixing, and help clarify the anomalous mixing behavior reported for polyolefins.

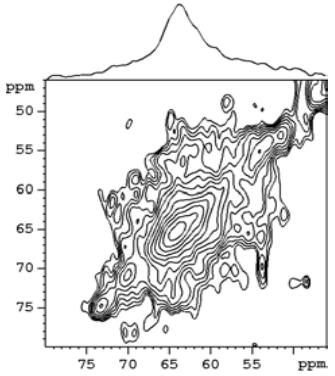
-Macromolecules 2003, v. 36, p. 4844
-Macromolecules 2004, v. 37, p. 4573
-J. Amer. Chem. Soc. 2003, v. 125, p. 13660



TOP: Schematic of mixing length scales derived from solid-state ^{2}H and ^{129}Xe NMR data in **(a)** a blend of PIB with PEB containing a small concentration of butene comonomer vs. (b) or (c) in which the PEB contains 50 mole % butene comonomer. **BOTTOM:** Example of 2D exchange data for pure PIB (left) vs. PIB blended with the sample in (b) or (c) above (right). This demonstrates how the individual chain dynamics, and thus configurational entropy, may be accessed in blends.



pure: τ_{ex} = 1.5 sec



blend: τ_{ex} = 0.10 sec

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Education:

Two Ph.D. students have been supported under this grant: Mr. Xin Jia, who will graduate in December, 2004, and Ms. Justyna Wolak, who will graduate in May, 2005. Ms. Wolak was honored for her work under this grant by an APS Frank J. Padden Award, in which she presented her work at the 2004 National APS meeting in Montreal. Also, Ms. Leiddy Alvarado has been supported via an NSF-REU supplement for the summer of 2004.

Outreach:

The PI has established an active recruiting program for both summer interns and graduate students in the University of Puerto Rico system. To date, two NSF-REU students (Rosimar Rovira and Leiddy Alvarado) have come to the PI's group. In addition, the PI and graduate students have participated in high and middle school demonstrations, career fairs, and expos during the year. Finally, through this grant and additional support from the National Research Council, an active collaboration with the Polish research group of S. Jurga has been established. As a result of this collaboration, students pursuing advanced degrees in Poland have spent 2 months in the PI's lab during the last year working on this project, leading to two publications.